Hering had shown that this phenomenon is a function of the condition of dark-adaptation produced by feeble illumination rather than a function of the feeble illumination itself, and von Kries shows that the changes of relative brightness are readily explicable if we suppose that, as the eye becomes more and more dark-adapted, there comes into play a new factor which has no influence, or no appreciable influence, at ordinary luminosities. Speaking roughly, the blue end of the spectrum becomes relatively brighter, and it is this end of the spectrum which has the greater action on visual purple.

In pronounced dark-adaptation the spectrum is seen as a colourless band of light, and the curve of luminosity of the spectrum in this condition shows a close correspondence with the curve representing the degree of action of different parts of the spectrum on visual purple. The spectrum is shortened at the red end; it is brightest in the green, and the diminution of brightness towards each end is much more gradual on the blue than on the red side of the maximum.

Visual purple also furnishes an explanation of an anomaly of colour vision which has long puzzled physiologists. A colour-equation which is good for one luminosity is not good for all luminosities, and von Kries shows that the mixed light which becomes relatively brighter at low luminosities is that which has the greater action on visual purple.

The absence of visual purple from the *fovea centralis* provides a ready method of putting the theory to the test. If dark-adaptation with its influence on colour-brightness and colour-equations be due to visual purple, the *fovea* should not share in the increased sensitiveness of the dark-adapted eye, nor should this region show any change in colour-brightness or in colour matches in different conditions of adaptation.

There seems to be no doubt that the *fovea* responds in favour of the theory. There is some difference of opinion as to whether this region fails entirely to show alteration of sensitiveness, but it is generally agreed that any increase which occurs is insignificant compared with that of the surrounding region of the retina. Very careful observations by Nagel and others seem also to show conclusively that Purkinje's phenomenon and the alteration of colour-matches are absent if the stimulation of the retina be strictly limited to the foveal region. The features of colour vision which are believed to depend on visual purple are absent just when, according to the theory, they should be absent.

One of the most interesting developments of the theory is that in which the condition of total colour-blindness is regarded as vision dependent chiefly, or exclusively, on the visual purple of the rods. Hering was the first to show that the curve of luminosity of the spectrum in most cases of total colour-blindness corresponds with great exactness to the curve of luminosity of the normal dark-adapted eye, and von Kries shows that there are other points of close resemblance between the two conditions.

If visual purple be the basis of monochromatic vision, there ought to be a central blind spot, and in several cases which have been examined from this point of view by quite independent observers, this has been found to be the case. Again, the behaviour of the *fovea* is in favour of the theory. The evidence here, however, is not unanimous. Hess has failed to demonstrate the existence of a central scotoma in several cases, but our knowledge of the exact distribution of rods and cones in the human *fovea* is based on very few examinations, and it is possible that there are wide individual variations, and that in some people an area devoid of rods may be absent, or so small that it is impossible to demonstrate its presence. The diffusion of visual purple into the rod-free area is also possible in some cases, but it seems more probable, from a study of the evidence as a whole, that there are two kinds of total colour-blindness, and that in only one of these is it probable that visual purple is the only sensitive substance in the retina.

Several of the papers in the "Abhandlungen" deal with the recurrent image, or "ghost" of Bidwell, which is believed by von Kries to be a "visual purple" phenomenon. This part of von Kries's work has been much attacked, and recent work seems to show that the recurrent image is a much more complex phenomenon than has usually been supposed. It is probable that visual purple is only the basis of one of the elements of the complex.

The comparative evidence is in favour of the theory, visual purple being abundant in nearly all vertebrates the habits of which are nocturnal or which live underground.

It has only been possible here to give the briefest sketch of the views of von Kries and his co-workers. The "Abhandlungen" should be consulted for the elaborate investigations and detailed arguments in support of their views. W. H. R. RIVERS.

OUR BOOK SHELF.

Botanische Forschungen des Alexanderzuges. By Dr. H. Bretzl. Pp. xii+412. (Leipzig: Teubner, 1903.) Price 12 marks.

THE criticism passed by Sachs in his "History of Botany" on the writings of the ancient classical writers, including Theophrastus, seems to have been unnecessarily severe where he passes over their "corrupt texts" with a brief mention. At that time the study of geographical and ecological botany had not received the stimulus which was mainly induced by the appearance of Schimper's master work, "Die Pflanzengeographie." It would hardly be going too far to say that it required the development of this branch of the subject to admit of the full appreciation of Theophrastus's work. For the essential feature of Theophrastus's "Plant Geography," and this book is the main source of information concerning Alexander's expedition, is the painting of a series of word pictures, illustrations of types of vegetation, in which, while correct morphological ideas could hardly be looked for, the descriptions, in their accuracy of observation and power of expression, are not often excelled by those due to present-day writers. As might be expected, some of the accounts are difficult of explanation, and discrepancies arise which have demanded considerable skill and enthusiasm on the part of Dr. Bretzl to clear up. Others are more obvious; thus the paragraph which begins:—

"*ὑποβέβρωται δὲ ταῦτα τὰ δένδρα πάντα κατὰ μέσον ὑπὸ τῆς θαλάττης καὶ ἕστηκεν ὑπὸ τῶν ῥιζῶν ὥσπερ πολύπους*" calls up very definitely the picture of a mangrove swamp.

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Even more striking is the description of a mimosa which grew near Memphis:—"*ὅταν δέ τις ἅψηται τῶν κλωνίων ὥσπερ ἀφαναινόμενα τὰ φύλλα συμπίπτειν φασίν, εἶτα μετά τινα χρόνον ἀναβιώσκεσθαι πάλιν καὶ θάλλειν.*"

Here the difficulty arises with regard to the species which is denoted, but special investigation by Dr. Schweinfurth elicited the information that in the vicinity there grows *Mimosa asperata*, a plant the sensitivity of which is almost unknown to botanists. Another graphic description is that of the banyan, *συκῆ Ἰνδική*, with the allusion to the roots developed from the branches, which are roots because they are lighter in colour and *leafless*. But the book contains many similar points of interest, and Dr. Bretzl has furnished abundant proof of the accuracy of perception and faculty of discernment possessed by some of the ancient Greeks.

The sources of information are to be traced to the memoirs of certain of Alexander's retinue. These manuscripts, which were deposited in Babylon, have unfortunately been lost; but they were apparently available to Theophrastus, who has worked up the material with truly remarkable intuition. Between the writings of Theophrastus and those of other authors, notably Pliny, Dr. Bretzl draws a sharp line of distinction, the distinction, in fact, between the original thinker and the annotator.

Practical Plane and Solid Geometry for Elementary Students. By Joseph Harrison. Pp. xiii + 250. (London: Macmillan and Co., Ltd., 1903.) Price 2*s*. 6*d*.

THIS little book will be found very useful for the teaching of the fundamental principles of geometry to young students. The most important properties of triangles and other plane figures are illustrated by means of accurate drawing and numerical calculation, and thus appeal more readily to the understanding and memory than if the beginner were made acquainted with them by means of the severe and tedious logic of Euclid. The great advantage of such a book as this is that it prepares the mind of the beginner for methods of accurate logical demonstration at a later stage in his studies. The very large number of numerical exercises requiring calculation and the use of instruments should suffice to give the student a very firm knowledge of all the important part of elementary geometry; and for this reason the book can be confidently recommended to teachers.

The first ten chapters are of this useful kind; then follow some chapters on the nature of vectors and their addition, including some properties of uniplanar forces acting on a particle the necessity for which may, perhaps, be doubted. In these chapters we meet with a little careless writing which, doubtless, will be corrected in the next edition. Thus, the first sentence (or what should be a sentence) on p. 118 reminds us of Mr. Skae's item in "The Jumping Frog": a verb is missing and no assertion is made. The use of the expression "in *tandem*, or *follow-my-leader*" to indicate cyclic order in the sides of a triangle is of doubtful propriety; but such trifles constitute, of course, no serious objection.

The notation l_θ for the magnitude and direction of a vector (p. 130) is distinctly useful in the composition of vectors. Chapter xiii., on concurrent forces, will, of course, be omitted by the beginner whose aim is to acquire only a knowledge of the elements of geometry; and it scarcely belongs to the subject.

The remaining five chapters deal with geometrical drawing in three dimensions, and they constitute a very good introduction to the subject, the figures being very numerous, and accompanied by a large number of numerical examples.

Die Aluminium-Industrie. By Dr. F. Wintelen. Pp. xi + 108. (Braunschweig: Friedrich Vieweg und Sohn, 1903.) Price 6 marks.

THIS very interesting monograph upon the aluminium industry commences with a short historical introduction, in which we learn that Davy, so far back as 1808, after he had discovered sodium and potassium, endeavoured to prepare aluminium by electrolysing alumina. In this he was not successful, and it fell to the lot of Wöhler in 1827 first to prepare the metal by purely chemical methods. Bunsen, however, was able in 1854 to obtain it by electrolysing its chloride. In a table on p. 5 the variation in the price of the metal is traced since 1854, when it was merely a chemical curiosity. Its value in that year was 120*l*. per kilo, and even in 1889 it cost 2*l*.; but with the improvements of the electrical methods, the price rapidly dropped, until in 1901 it ranged from 2*s*. to 2*s*. 6*d*. per kilo. Following the historical portion of the work, a very full account of the physical and chemical properties of the metal is given. It is not until we reach p. 22 that the present methods of obtaining the metal are gone into, but here the thoroughness of the treatment leaves nothing to be desired. In the first place a careful account of the preparation of the outgoing materials used in the manufacture is given. This part of the work is of very considerable value. Everyone is aware that bauxite and cryolite are the substances used for preparing aluminium, and those who have studied the subject know that these substances cannot, as a rule, be employed without being first purified. In this book the methods of purification are described in detail, and methods of analysis are also set forth. Page 54 is headed "carbon electrodes"; these are employed both for the anode and kathode, in consequence of impurities introduced into the bath when other electrodes are used. The author gives details of the manufacture of these carbon electrodes—ten pages are devoted to this. Some useful diagrams illustrating the way in which the electrodes become corroded during the electrolysis are also given.

The last few pages of the monograph are devoted to the "working up of the metal"; one of the most interesting points being the method for welding the metal which is employed by Heräus, of Hanau. It consists in heating aluminium sheets with a hydrogen flame to a temperature of about 400°. The edges are then pressed together, and after being worked for some time with the hammer, they weld together in such a manner that tubes made in this way can hardly be distinguished from seamless ones.

This monograph is one of the most interesting and useful which we have had the pleasure of reading for a long time. The facts are well arranged, and although there are 108 pages devoted to the single subject of the aluminium industry, we do not consider that the work suffers from prolixity; we wish this could be said of many German monographs which have lately been published.

F. M. P.

Die Konstitution des Kamphers und seiner wichtigsten Derivate. By Ossian Aschan. Pp. xi + 117. (Braunschweig: Friedrich Vieweg und Sohn, 1903.) Price 3.50 marks.

THE chemistry of camphor and its derivatives has occupied the attention of chemists for many years, and has now become so specialised that it is almost impossible for the ordinary chemist to keep up with the immense amount of research published in the journals devoted to chemistry. The monograph by Prof. Aschan is accordingly very welcome, and will be found useful not only by the non-camphor chemist, but also

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